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United States
Environmental Protection
Agency

Health Effects Research
Laboratory
Cincinnati OH 45268

Research and Development

EPA-600/S1-81-040 July 1981

EPA

Project Summary

Temporal Variability of Toxic Contaminants in Animal Diets

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Uncertified commercial research animal feed (Purina Chow™) was analyzed over forty-one months to determine essential and trace elements and toxic contaminants. Parametric statistics and graphic chronologic progressions of the results are presented for cat, monkey, rodent (rat/mouse), guinea pig and dog diets. Concentrations of toxic contaminants are discussed in terms of Maximum Allowable Concentrations (MAC) proposed by EPA. The impact of undesirable contaminants on *in vivo* animal studies is analyzed. Practical aspects of cost-effectiveness of feed analysis in a major research setting is discussed.

This Project Summary was developed by EPA's Health Effects Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

In recent years increasing attention has focused on nutritional and toxicological qualities of feed and water administered to experimental animals. Governmental regulations were proposed by the Food and Drug Administration and by EPA to control quality of nonclinical animal testing. Within the broad range of requirements for quality assurance, the Good Laboratory Practices (GLP) regulation mandates description and periodic analysis of animal feed.

Maximum Allowable Concentrations (MAC) for critical toxic substances in feed have been proposed by EPA based on the recommendation of the National Research Council's Committee for Long Term Holding of Laboratory Rodents.

In spite of the growing concern about feed contamination, only limited information is available in the literature about types, sources and timing of contamination.

In the past literature several authors dealt extensively with rodent feed contamination and its potential impact on toxicological procedures. Literature listings of multiple assays on rodent chow provide neither source nor chronology of sampling.

Objectives

This report summarizes our laboratory's experiences since mid-1976 in testing uncertified animal diets. In compliance with Agency-wide policy for quality assurance and in anticipation of the imminent GLP regulations, we initiated analyzing all batches of feed purchased from Purina. The mode of analysis was retrospective, e.g. sampling and analysis was done immediately upon receipt of the feed lot. Assay data was available a month later, by which time the feed was dispensed for consumption.

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The project included six diet types, and thirty components were assayed in each of these formulae during varying segments of 41 contiguous months, from June 1976 to December 1979 inclusive. Classification of these was as follows:

- Essential elements, for which the manufacturer specifies values in composition charts.
- Toxic elemental and molecular contaminants for which MACs have been proposed by EPA.
- Elements of undefined significance. The manufacturer neither attempts to control these, nor provides statements regarding levels in feed.

The intent of this report is to: provide a chronological "snapshot" of a popular commercial feed; discuss the appropriateness of MACs; and evaluate methods of feed analysis.

Conclusions

Essential Elements - The range of variations indicated reasonably rigid control in the manufacturing process. Mean concentrations of each elemental component were comparable across feed types, and corresponded to those listed by the manufacturer in composition charts.

Toxic Contaminants

Cadmium - More than one third of all observations on all feed types exceeded the EPA limit. Had we obtained the monthly analytical data before we administered the feed to our rodents, based on the EPA MAC, we would have had to reject 34% of the lots. In practice, the exclusion of the diets exceeding the arbitrary MACs was not necessary due to the nature of the studies being undertaken in our laboratory.

Lead - The variability of this element was particularly high in cat, monkey and rodent chows. The ambient range in rodent feed presented a practical concern to our investigators because of a previous experience. During 1978, a large rat cross-fostering study involving low lead levels in drinking water had to be invalidated because of an outlier (2.59 mcg/g) lead level occurring in rodent chow.

Mercury - This contaminant was detected only in June 1979 in cat and rodent feeds, both being lower than the MAC recommended by EPA.

Arsenic - Arsenic appeared to be the most variable of all contaminants across feed types but none of the observations exceeded the EPA MAC.

Selenium - The chronological progression of this element showed sudden and simultaneous elevation in all feeds, followed by persistence and slow decay during the period studied. The biological significance of this incidence could not be assessed.

Malathion - Malathion was the most stable and best controlled pesticide residue in all diets tested.

DDTs - DDTs were ubiquitous contaminants appearing in spikes at regular frequency throughout the study, suggesting seasonality.

PCBs - Rodent diet, the most frequently encountered in toxicological laboratories, showed two instances of contamination. Based on levels obtained, it is our conclusion that the contamination peaks were not sufficient to alter liver function in our animals. However, PBCs are known carcinogens and based on this fact, we would have probably discarded the contaminated lots had we known beforehand.

Since electrical equipment containing PCBs is still in use in feed processing plants, accidental spills are possible to occur. Therefore, the need for pre-administration surveillance of PCB is warranted.

Aluminum - In view of our experiences one cannot speculate as to the significance of aluminum in animal feeds. The highest observed level in rodent feed was about 10-fold over the level one might find in human food (oatmeal) cooked in aluminum pots. From the analytical data, it is not possible to discern in what chemical form aluminum was present in animal feed.

Barium - The cardiovascular toxicity of this element received considerable attention, especially in view of its abundance in drinking water. Therefore, feed barium levels are of significant interest to many researchers.

An example of this concern emerged in our laboratory when the rate of gastrointestinal absorption of naturally occurring barium in drinking water was studied in rats. The study had to be repeated after the investigators realized that the ambient feed levels interfered with the interpretation, since the rat chow contained 2-5 times the amount of barium that was present in the water sample studied.

Strontium and Boron - Very little is known about the potential impact of these contaminants in the ppm range in animal studies. The levels detected are documented.

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The complete report, entitled "Temporal Variability of Toxic Contaminants in Animal Diets," (Order No. PB 81-205 973; Cost: $8.00, subject to change) will be available only from:

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